Puritan Bennett

GoodKnight® 425

GoodKnight® 425ST

SERVICE MANUAL

P/N: M-145MAT00-20 *Revision A*

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PREFACE

This manual provides information necessary to service the GoodKnight 425 and the GoodKnight 425ST Respiratory System. This information is intended for use by technicians or personnel qualified to repair and service medical equipment. The information is not exhaustive and may not be applicable to future models.

DEFINITION OF STATEMENTS

Statements in this manual preceded by the followings words are of special significance.

WARNING

Means there is the possibility of injury or death to yourself or others.

CAUTION

Means there is the possibility of damage to the GK 425/425ST unit or other property.

NOTE

Indicates points of particular interest for more efficient and convenient operation.

REVISION LIST OF
GoodKnight 425 / 425ST Service Manual

This list of effective pages represents manual **P/N M-145MAT00-20**, **revision A**.

Revision	Description	Date
A	Initial Release.	05/2004

Effective Pages	Revision	Effective Pages	Revision
All pages	A		

Rx ONLY

Federal law restricts this device for sale by or on the order of a physician.

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I - GENERAL INFORMATION

A. SPECIFICATIONS

1) Performances

GoodKnight 425 and GoodKnight 425ST

- Pressure adjustment range
  - IPAP: 3 to 25 cmH_2O in 0.5 cmH_2O increments (see note 1)
  - EPAP: 3 to PIP (maximum 20 cmH_2O)
- Pressure setting accuracy: ± 0.5 cmH_2O (see note 2)
- Flow range: 0 to 90 l/min @ 3 to 25 cmH2O (while maintaining pressure setting accuracy)
- Ramp (adjustable): disabled, or 5 to 30 min in 5 min increments
- Rise Time (rt): 1 to 5 in 1 increment
- Expiratory / Inspiratory sensitiviy: 1 to 10 in 1 increment

GoodKnight 425ST only

- Backup Frequency: Disabled (0) or activated 4 to 25c/min
- I/E ratio: 1:4.0 to 1:0.5 in 1:0.5 increment
- **Setting restrictions:** The maximum duration of the IPAP pressure is limited to 3 seconds. Consequently certain combinations of frequency, rise time and I/E ratio will be forbidden, especially for low frequency setting.
  As well, certain combinations of frequency, rise time and I/E ratio which prevent the IPAP set pressure to be reached will be forbidden, especially for high frequency setting.

NOTE 1

The display can be in "hPa". The pressure adjustment range is then between **2.9 hPa and 24.5 hPa**. To select the unit, unplug the device, depress the hidden key and reconnect the device, keeping the hidden key depressed until the unit is displayed.

NOTE 2

All the stated performances are for a 6 ft (1.80-meter) patient circuit, recommended by the manufacturer, fitted with a stopper with a 4 mm diameter leak.

2) Electrical specifications

Power supply

- External Power Supply Class II — 100-240 VAC 50/60 Hz—13VCC 4A

Goodknight

- Consumption — 40 VA max.
- Current consumption — 1.1A @ 25cmH_2O with 4 mm leak

3) Environmental specifications

- Storage / Transport temperature — -20° C to 60° C
- Storage / Transport humidity — up to 95 % (non-condensing)
- Operating temperature — +5° C to +40° C
- Operating humidity — between 15 % and 95 % (non-condensing)
- Operating relative pressure — 700 hPa to 1060 hPa (approximately up to altitude of 7874 ft -2.400 m)

4) Physical specifications

- Width — 5.6” (144 mm)
- Height — 2.9” (79 mm)
- Length — 7.7” (198 mm)
- Weight (without external power module) — 1.58 lbs (780 g)

5) Pressure stability (static mode)

The measured pressures are the pressures measured under a positive airflow continuous of 100 l/min. These measurements were made with a single unit.

Set Pressure (cmH_2O)	Measured Pressure (cmH_2O)
4	**3.8**
8	**7.8**
12	**11.7**
20	**19.9**

6) Dynamic resistance

The values below were measured from a simulated sinusoidal respiratory signal with a tidal volume of 500 ml after a warm-up period of 2 hours. These measurements were made with a single unit.

Pressure @ Frequency	Variation in pressure (CmH_2O)	Variation in airflow (l/s)	Dynamic resistance (CmH_2O/l/s)
7cmH_2O @ 10c/min	0,28	0,66	0,42
7cmH_2O @ 15c/min	0,37	0,98	0,38
7cmH_2O @ 20c/min	0,58	1,28	0,45
14cmH_2O @ 10c/min	0,38	0,70	0,54
14cmH_2O @ 15c/min	0,43	1,03	0,42
14cmH_2O @ 20c/min	0,64	1,33	0,48
20cmH_2O @ 10c/min	0,58	0,88	0,58
20cmH_2O @ 15c/min	0,50	1,07	0,47
20cmH_2O @ 20c/min	0,64	1,26	0,51

B. USING A HUMIDIFIER

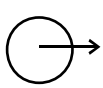
A heating or non-heating humidifier may be used with the GoodKnight 425 / 425ST on the condition that the following warnings are noted.

WARNING
You are strongly advised to read the manufacturer's recommendations for the humidifier before use.

WARNING
Using a humidifier can alter the performance of the GoodKnight 425 / 425ST.

WARNING
The GoodKnight 425 / 425ST must always be placed above the humidifier. This position will minimize the potential for water entering the Cpap device.
Water can damage the device.

C. SYMBOLS

SYMBOLS	DEFINITIONS
~	Alternating current
⎓	Direct current
⧈	Class 2 Equipment
	Type B
	Warning ! Consult instructions before using this unit.
	On / Off
	Access to settings
	Ramp
RS-232	RS 232
△ ▽	Increase or decrease the adjustment values
IPX1	Device protected against the vertical falls of water drops.
Rx ONLY	Federal law restricts this device for sale by or on the order of a physician. (US Only)
	Input DC voltage 13 V
	Patient Output
C US	Device complies with the requirements of the Standard CSA C22.2 Nr 601-1. (Canada)

D. CLEANING INSTRUCTIONS

1) GoodKnight 425 / 425ST

Frequency	As necessary
How to clean	Wipe with damp cloth moistened with warm, soapy water. Wipe dry.

WARNING

Unplug the unit from all electrical power sources before cleaning. Do not allow water to enter the unit through any opening.

2) Air filter

Frequency	Inspect the air filter frequently by removing it from the back panel. Clean at least once a week or more often, if necessary.
How to clean	Wash in warm, soapy water. Rinse thoroughly to remove all soap. Pat dry with towel. Allow to air dry completely before reinstalling. Replace filter if worn or damaged.

⚠ CAUTION

Only the standard air filter can be cleaned. The fine filter supplied as an option and fitted in addition to the standard air filter, cannot be cleaned. It must be changed.

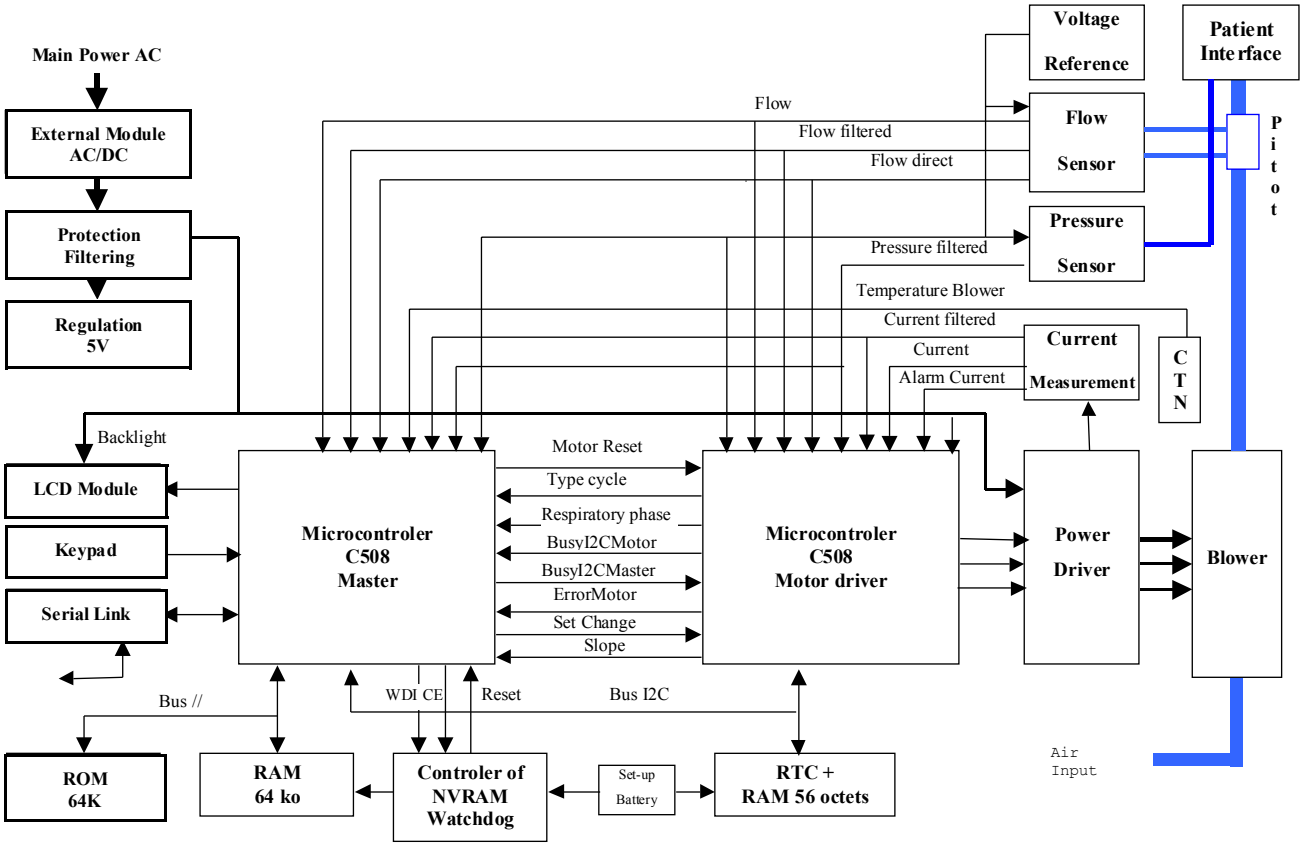
E. DISPOSAL OF THE DEVICE AT THE END OF ITS LIFETIME

In order to preserve the environment, the various parts of the device and its accessories must be disposed of at approved waste sites in accordance with current regulations.

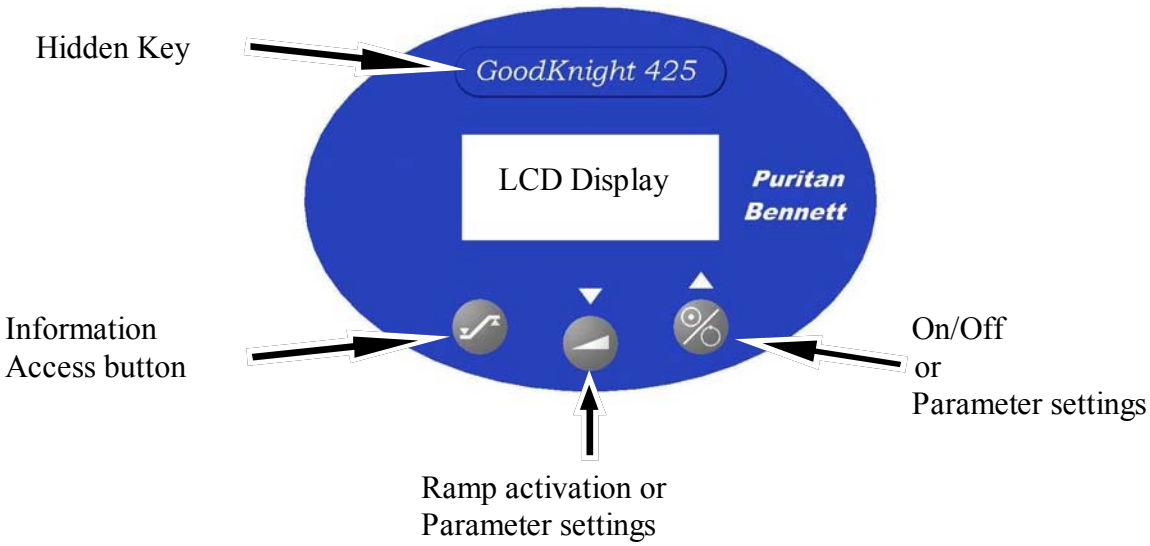
II - THEORY OF OPERATION

A. General description

1) General design synopsis



2) View of the control panel



3) Description

The general architecture of the device is based on the use of a blower (pressurised air generator) and two micro-controllers (one for the general functions of the unit and another one for the motor control).
Some functions are hardware-controlled, some are software-controlled and others are a mixture of hardware and software.

The GoodKnight 425 BiLevel is a BiLevel positive airway pressure device used in the treatment of obstructive sleep apnea or for the titration in the sleep lab of a patient having obstructive sleep apnea. It is intended to treat OSAS patients who are over 30 kg in weight (66 pounds).
In the BiLevel mode the GoodKnight 425 tracks patient breathing cycles and, in response to the patient's inspiratory and expiratory efforts, provides two levels of pressure :
-IPAP : a higher level of pressure for inspiration (a range from EPAP to 25 cmH2O)
-EPAP : a lower pressure for expiration (a range from 3 to IPAP or 20 cmH2O).
-If IPAP is equal EPAP, than the unit operates in CPAP mode.

The GoodKnight 425 BiLevel is a microprocessor-controlled pressure generator capable of controlling the pressure delivered to the patient. Among its operating features are:

* *GK425ST* in CPAP, BiLevel with and without backup frequency
* *GK425* in CPAP, BiLevel without backup frequency.
* Monitors pressure, respiratory rate, I/E ratio and compliance.
* Adjusts inspiration and exhalation flow-triggered sensitivity independently to provide precise patient comfort.
* Provides a maximum pressure setting of 25 cmH2O
* Compensates automatically for altitude and for leaks up to a total flow rate of 120 liters per minute, on top of the usual 4mm non re-breathing leak at 20 cmH2O.

The GoodKnight 420 Series benefits from a new blower technology that is specifically designed for this range of Cpap systems. This design provides optimum performances in terms of size, consumption, noise and stability.
In order to guarantee these optimum performances, some parameters are electronically tuned during the manufacturing process. These parameters are calculated for each blower and cannot be duplicated for another one. For this reason it is not possible to change a blower or an electronic board. In the event of failure, an internal chassis assembly fitted with a factory-set blower and electronic board is available.

4) Inspiratory and Expiratory sensitivity

The trigger of sensitivity can be set with a scale of 1 to 10.
1= The lower triggering level = The highest sensitivity,
10=The highest triggering level = The lower sensitivity.

5) Temperature Sensor

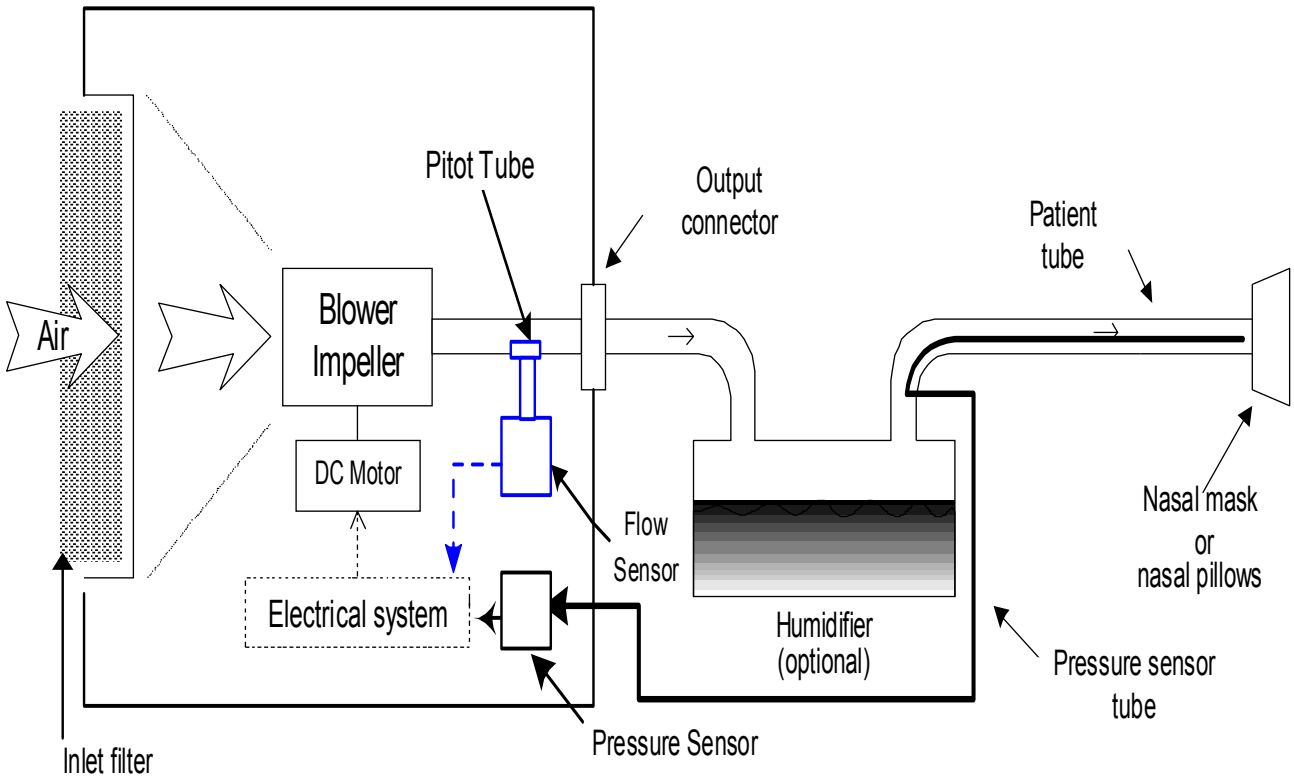
The stator of the blower is fitted with a temperature sensor which will protect the system against the overheating of the blower in the eventuality of a problem.
The GoodKnight BiLevel will stop working if the temperature goes above 95°C +/-5°C during 10 seconds.

6) Rise time (rt)

The rise time between EPAP and IPAP can be set from about 300ms/ 10 cmH_2O to about 600ms/10 cmH_2O. This rise time is adjustable on a scale of 1 to 5:

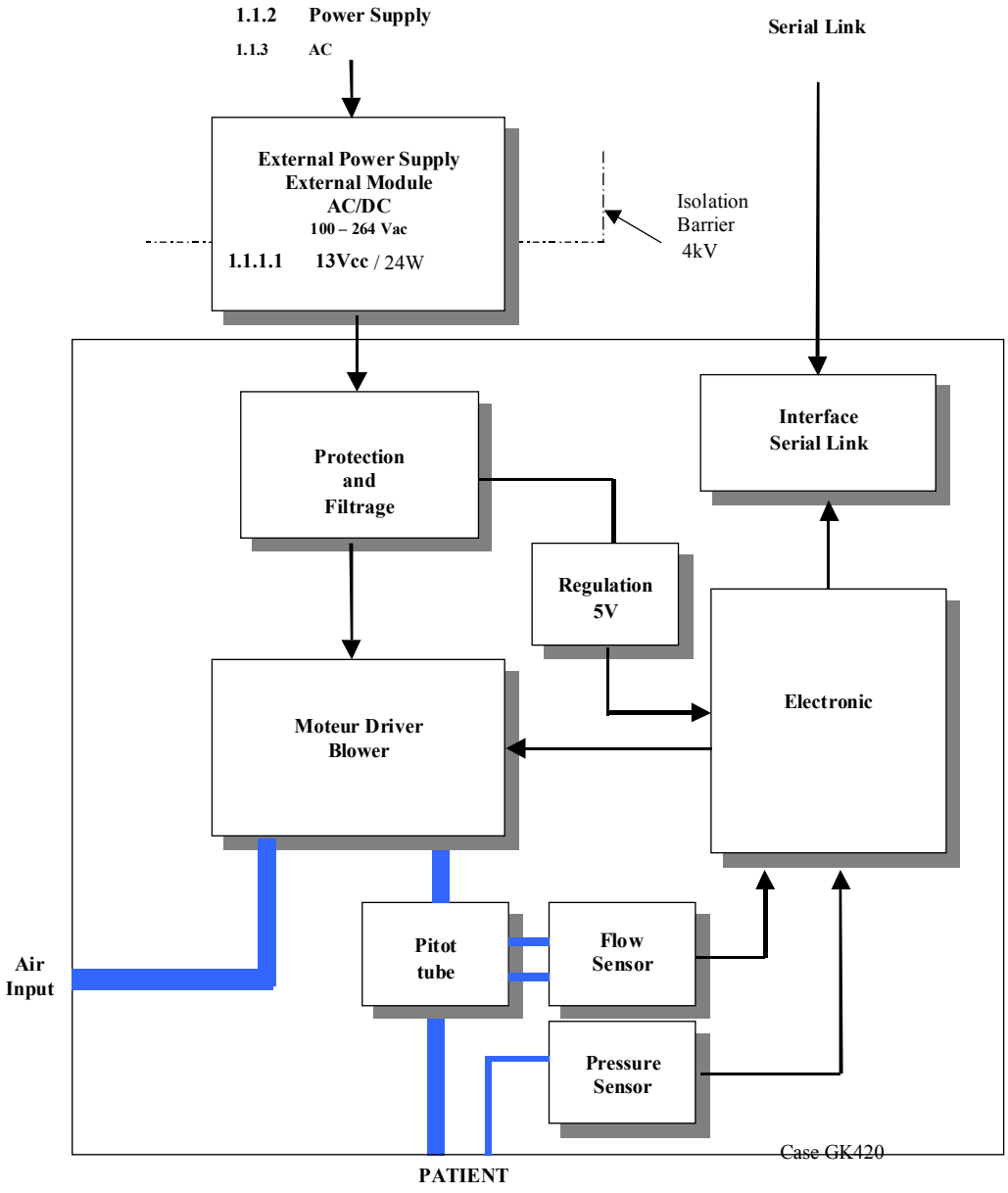
1 ≃ 300ms / 10cmH_2O
2 ≃ 375ms / 10cmH_2O
3 ≃ 450ms / 10cmH_2O
4 ≃ 525ms / 10cmH_2O
5 ≃ 600ms / 10cmH_2O

7) Pneumatic diagram



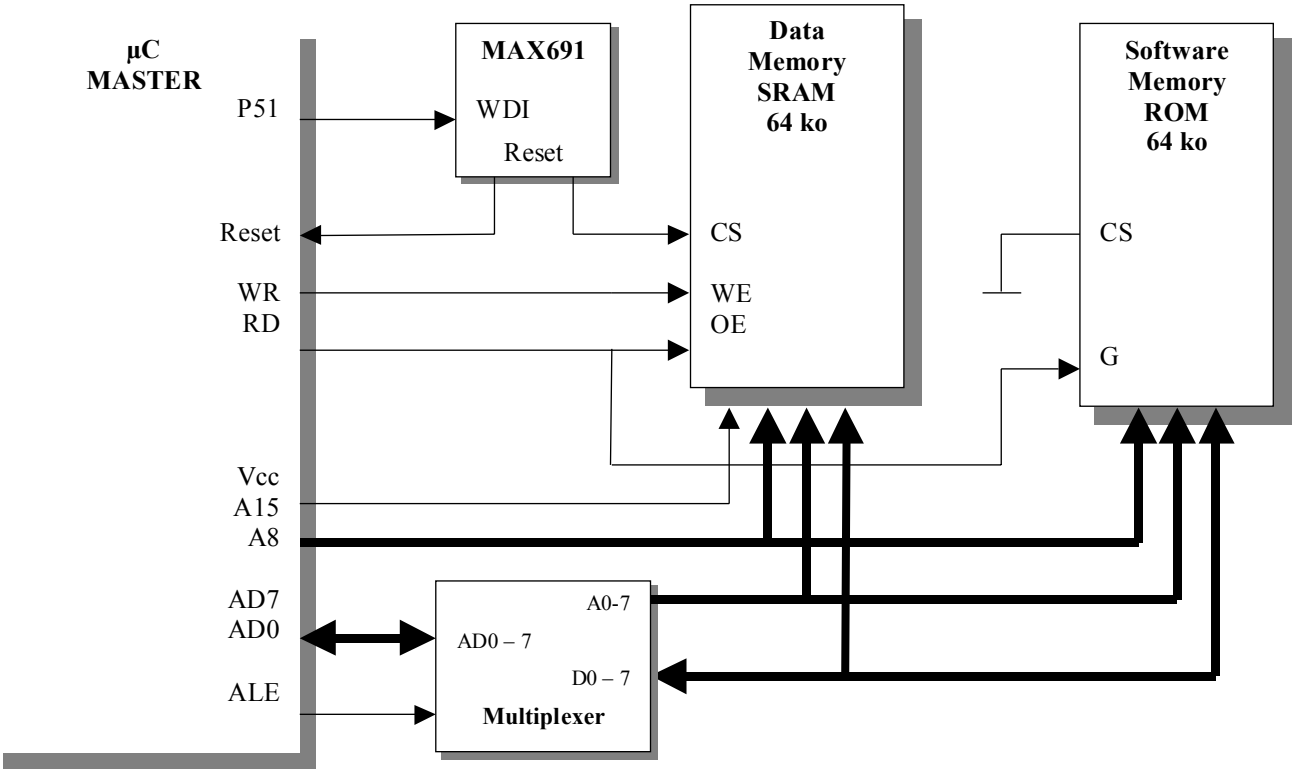
B. ELECTRICAL DIAGRAM

1) General block diagram

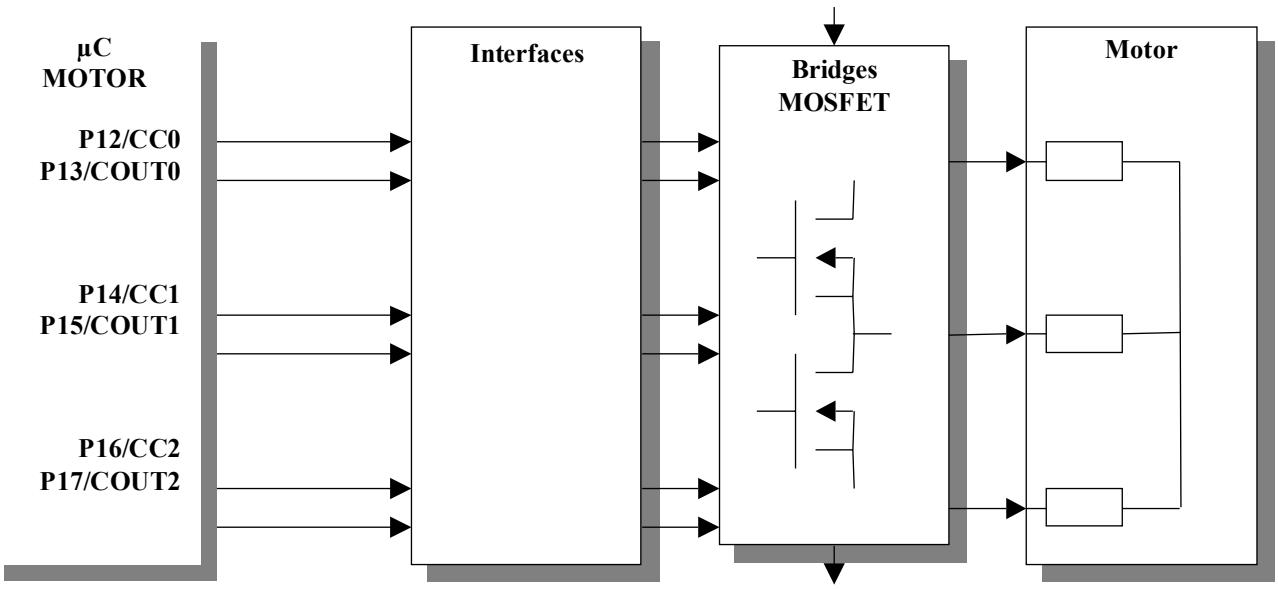


2) Micro-controller unit block diagram

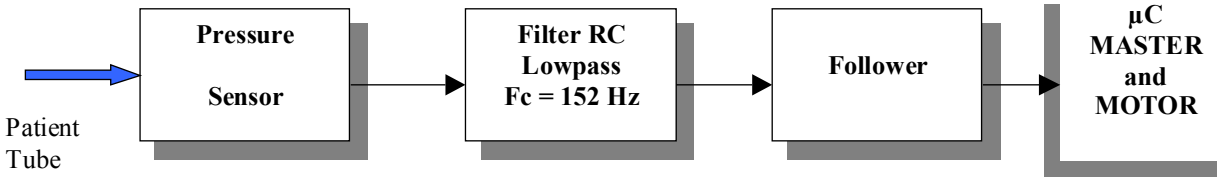
a) Micro-Master



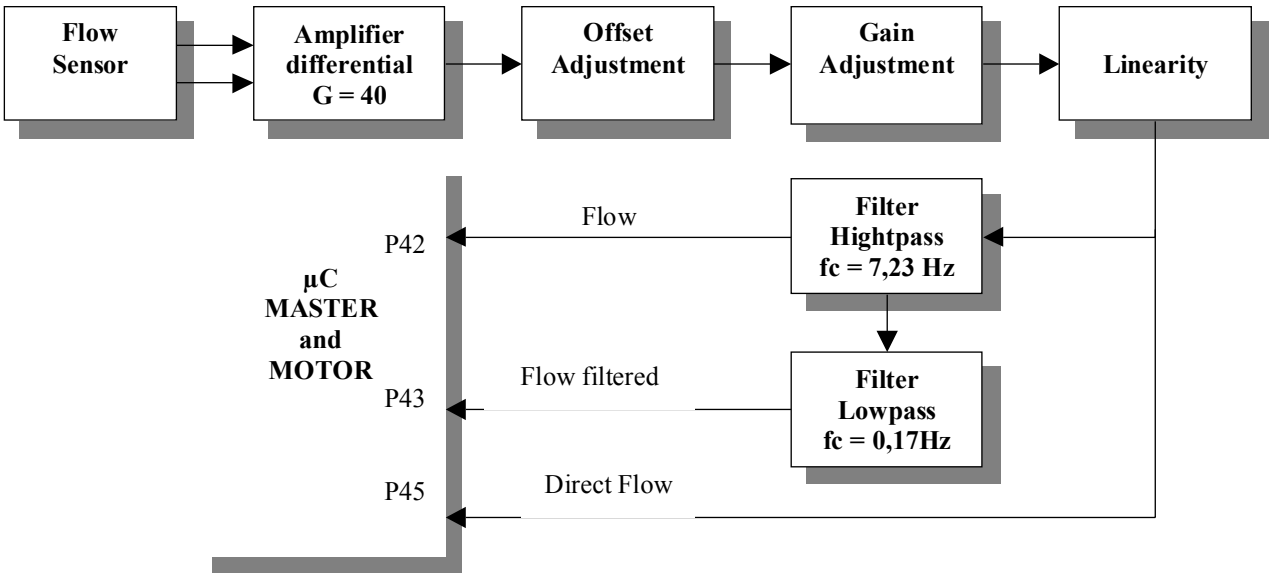
b) Micro-Motor



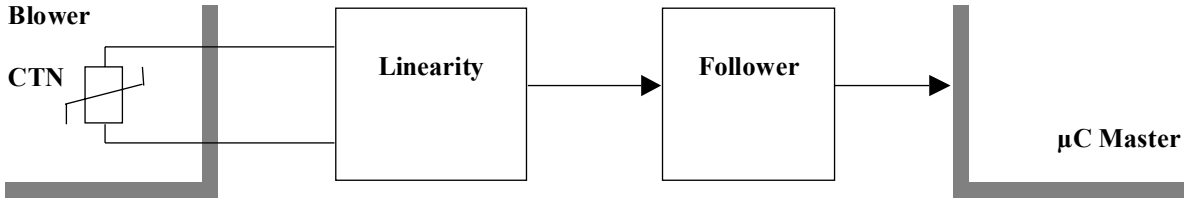
3) Pressure measurement chain



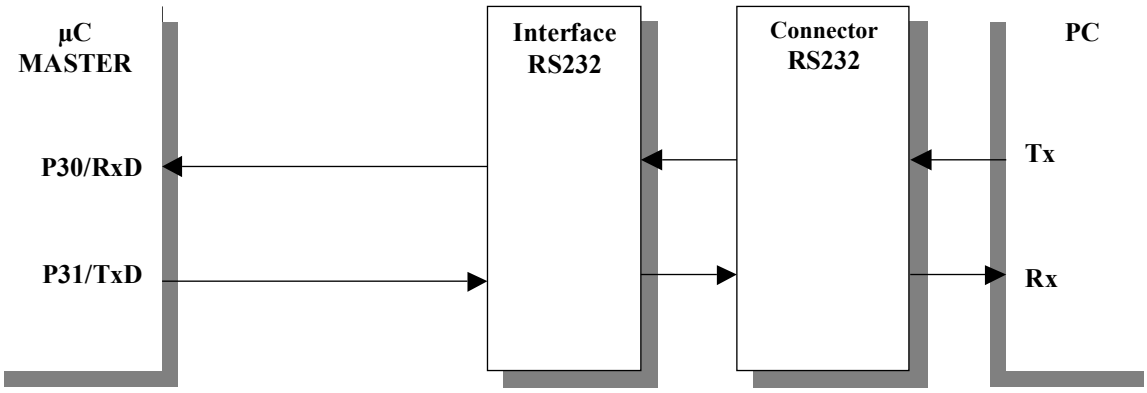
4) Flow measurement chain



5) Temperature measurement



6) Serial Link



III - SERVICE AND REPAIR

This section describes how to service the individual subassembly of the GoodKnight 425 and 425ST Cpap System. It includes instructions where applicable, for removal, disassembly, calibration, re-assembly and installation.

WARNING

The GK 425 and 425ST Cpap System is electrically powered. To prevent serious injury or death, follow standard safety procedures. Ensure that power has been disconnected from the unit before servicing any component.

WARNING

After a component has been serviced, the unit must be calibrated and the overall system operation checked according to the "Performance Verification" section, before the unit is returned to service.

⚠ CAUTION

Circuit boards contain complementary metal-oxide semiconductor (CMOS) integrated circuits (ICs) which are static sensitive devices. To prevent IC damage, follow the standard safety procedures :

-handle circuit boards by edges only,
-wear a grounded wrist strap,
-work on a grounded conductive mat
-store circuit board in a conductive plastic bag.

⚠ CAUTION

Allow to warm up for half hour before carrying out the performance verification and/or the calibration procedure.

A. PERFORMANCE VERIFICATION

1) General information

The performance verification should be carried out for any one of the following reasons:

- to determine the cause of operational failure,
- to check the overall operation of the GK 425/425ST system after repair,
- to check that the GK 425/425ST system is operating within specification.

During this verification, the following parameters will be tested :

-Pressure accuracy,
-Flow measurement chain
-Ramp and starting ramp pressure,
-Back-up frequency (425ST only).

2) Frequency

⇒ annually,
⇒ after repair.

3) Equipment required

- Calibrated pressure meter 0-30 cm H_2O (local source),
- Patient tube P/N : M-261000-27,
- Test kit P/N : M-212430-02 (consists of a coupling 22/22 mm and a stopper with a 4 mm diameter leak),
- PC computer with Silverlining software,
- Serial link cable,
- Calibrated leak M-BH0210 and connecting tube M-213530-05.

4) Preparation for testing

a - *Verification of the pressure*

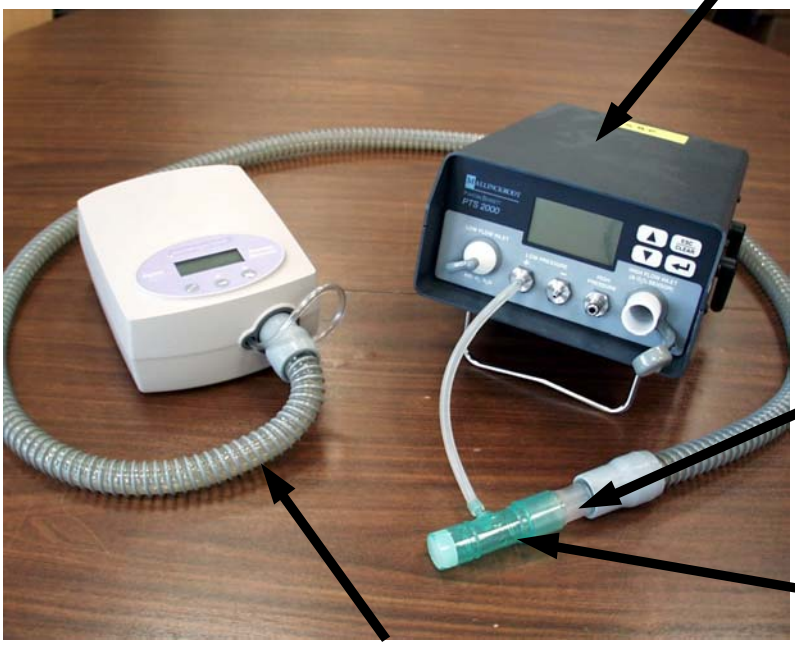


Figure 3-1

b - *Verification of the flow measurement chain*

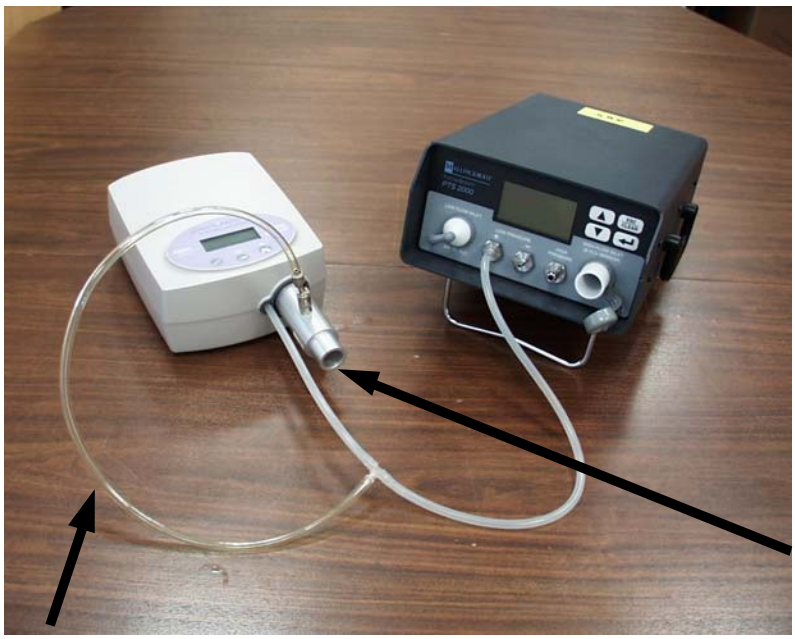


Figure 3-2

5) Performance verification with a computer.

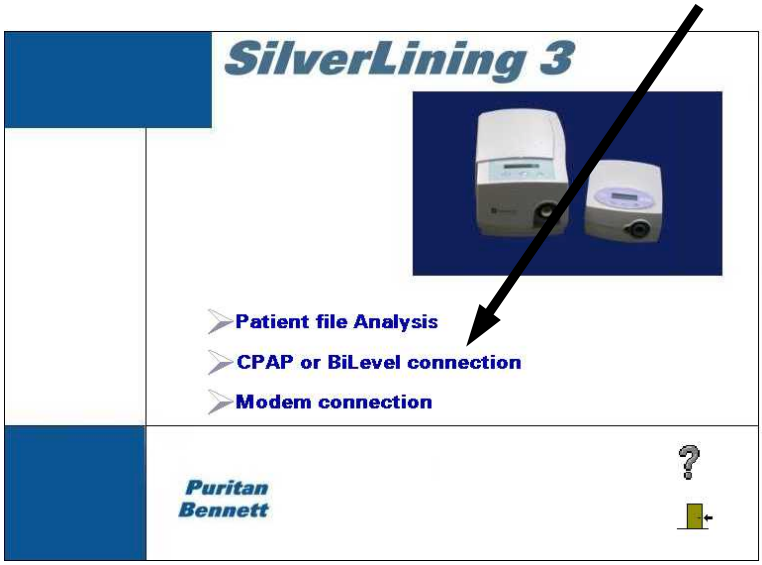
CAUTION

Allow to warm up for half hour before carrying out the performance verification and/ or the calibration procedure.

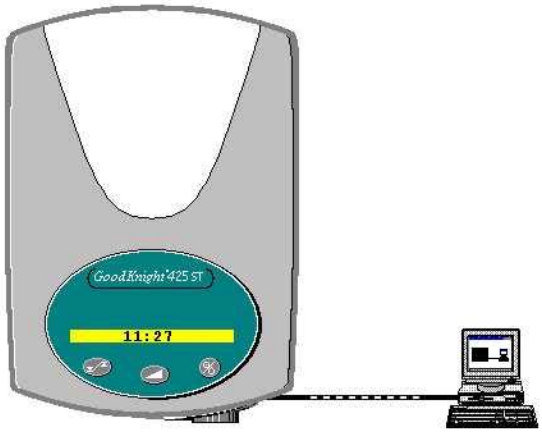
5-a) Preparation

- Set the material as shown on figure 3.1 page III-4
- Connect the GoodKnight 425/425ST to your PC,
- Open the Silverlining 3 software,
- The following menu appears,

Click on "CPAP or BiLevel connection "

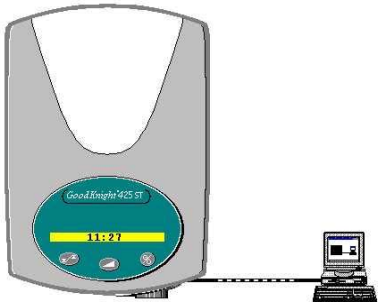


- The following display appears,



- Press the three following keys of your computer keyboard simultaneously:

- The following screen appears:

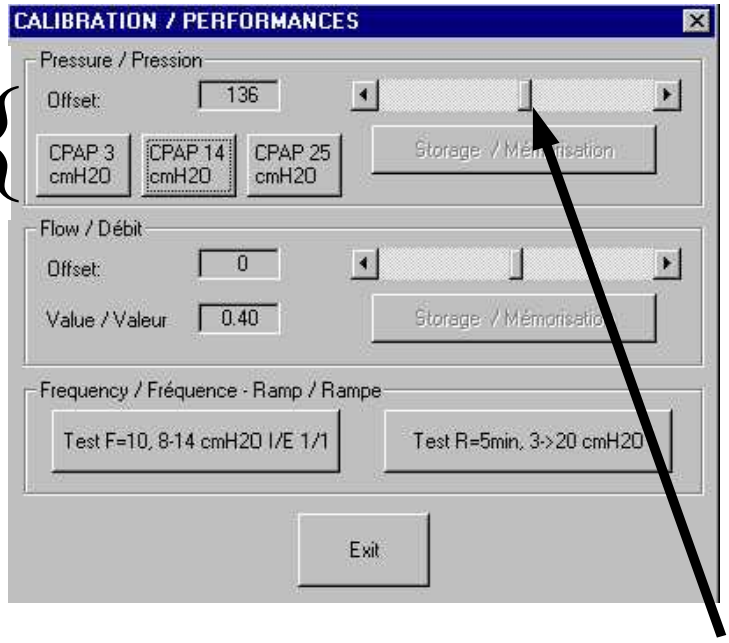


Note: In some case, depending of the computer, the combination of key (ctrl, alt, F9) does not operates. In this case press one time on the key « S » and then with the left button of the mouse click on the picture of the computer displayed on the screen.

- Enter the password. The password is given to technicians who have been trained by the manufacturer or a person accredited by the manufacturer.
- After entering the password, press the "Enter" key or click on OK. The following screen appears :

- Click on “Calibrations” and the following screen appears,

Menu "Pressure/Pression"



Setting cursor

5-b) <u>Pressure Verification and Calibration</u>

-Click on the button "14 cmH_2O" and verify that the pressure meter is reading:

14 $cmH_2O \pm 0,5$.

Adjust if necessary the offset of the menu "Pressure/Pression" with the setting cursor until the pressure meter is reading 14cmH_2O.

-Click on the button "25 cmH_2O" and verify that the pressure meter is reading:

25 $cmH_2O \pm 0,5$.

-Click on the button "3 cmH_2O" and verify that the pressure meter is reading:

3 $cmH_2O \pm 0,5$.

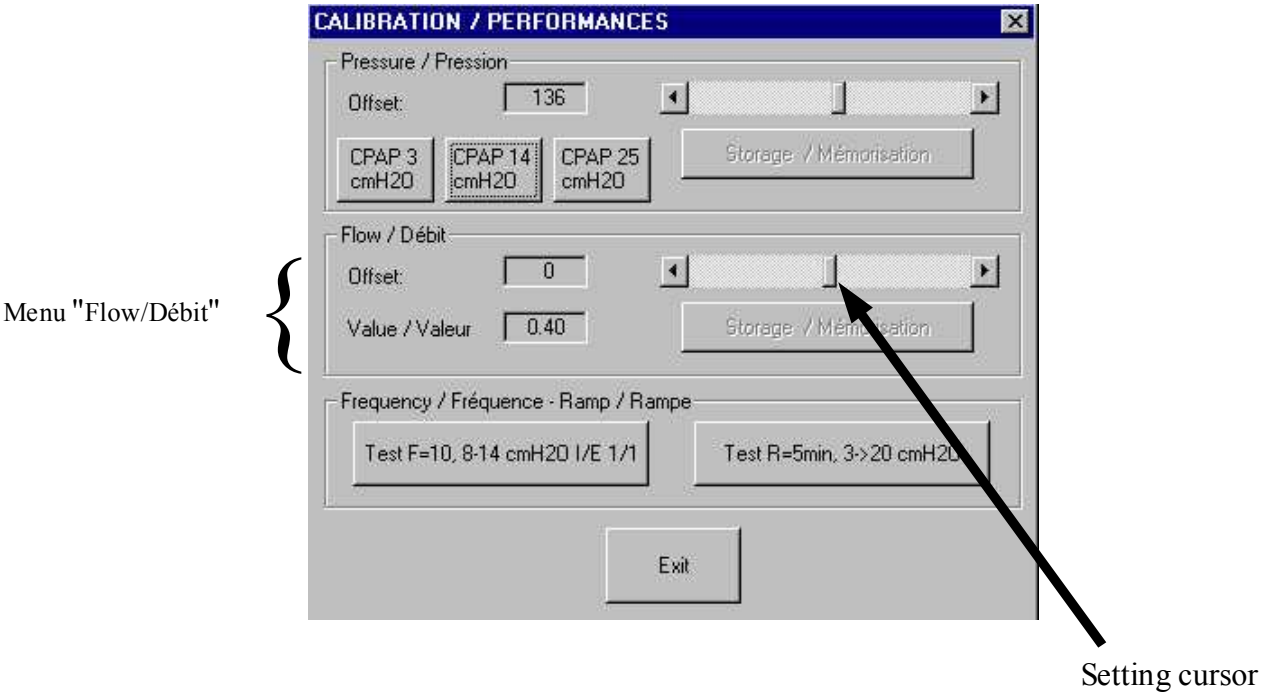
Click on the button " Storage/Mémorisation " of the menu "Pressure/Pression" to store the setting.

CAUTION

Allow to warm up for half hour (Cpap mode; P=14cmH_2O; plug test with 4mm leak) before carrying out the performance verification and/or the calibration procedure.

5-c) Verification of the flow measurement chain

Prepare the unit under testing as show in the figure 3.2 page III-4



-Set the pressure with 14 cmH_2O,
-**BLOCK** the calibrated output.

Step #1
-Wait for the "Value" reading on the screen to become stabilized,
-Verify that this "Value" of the menu "Flow/Débit" is reading:

0 l/s (+/- 0.1)

-If not, adjust the Offset with the setting cursor in order to read in the display "Value" 0 l/s +/-0.1, and then store with the button "Storage".
-If the value read is within specification, go to step #2.
-If the value reading is not within specification, perform the calibration of the flow sensor described page III-20. Do not go to the step #2

Step #2
-**Unblock** the calibrated output,
-Wait for the value reading on the screen to become stabilized,
-Check the value reading on the screen in the "Flow/Débit" menu is reading:

1.2 l/s (+/- 0.1)

-If the value reading is within specification, the verification is good.
-If the value reading is not within specification, perform the calibration of the flow sensor described page III-20.

5-d) Verification of the ramp

Click on the button "Test R" (Test of Ramp). The unit is set with a 5 minutes ramp, start pressure 3 cmH_2O , end pressure 20 cmH_2O.

Verify that the pressure runs from 3 to 20 cmH_2O in the time of::

5 minutes +/- 20 seconds.

5-e) Verification of the back-up frequency (425ST only)

Click on the button "Test F" (Test of Frequency). The unit is set with a frequency of 10 cycles / min.(IPAP=14; EPAP=8; I/E=1:1.0). Verify that the pressure is switching from EPAP to IPAP in 10 cycles +/- one cycles per minute.

The performance verification of the unit is now ended.
Click on the EXIT button to leave of the technical menu. The unit will retrieve its previous settings (settings before the technical action).

NOTE

Some verifications can be performed without a computer (section 6 page III-10). In order to do them you have to select the corresponding settings with the keypad. (refer to the sections verification of the pressure, the ramp and the back-up frequency in the following pages).
The verification of the pressure will not be total (maximum pressure in Cpap mode =20 cmH_2O).

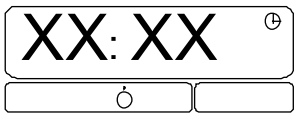
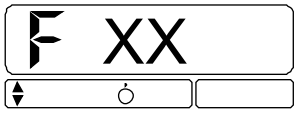
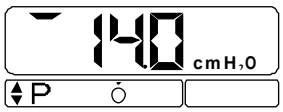
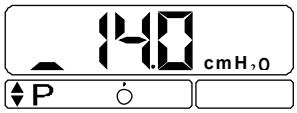
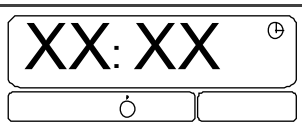
6) Performance verification with Keypad

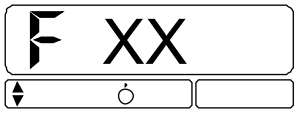
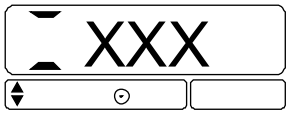
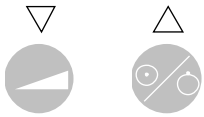
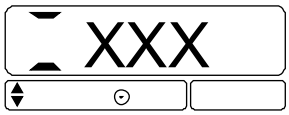
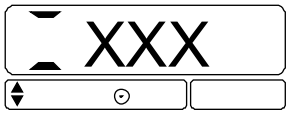
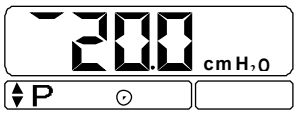
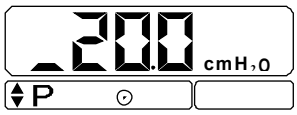
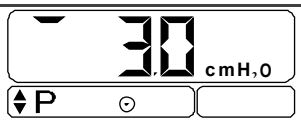
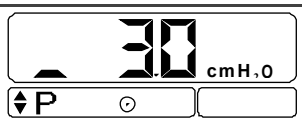
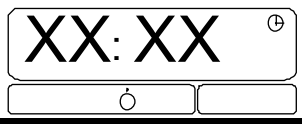
6-a) Verification of the pressure without computer

Set the material as shown on figure 3.1 page III-4

NOTE

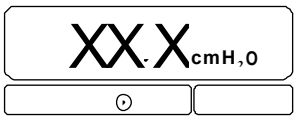
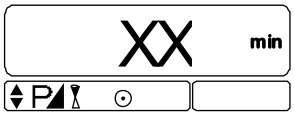
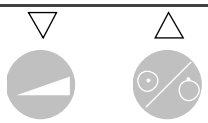
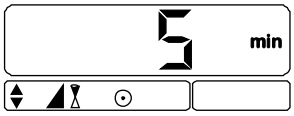
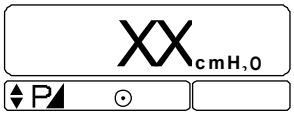
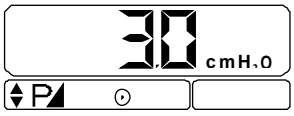
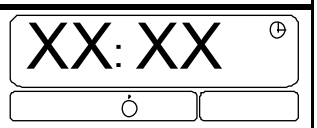
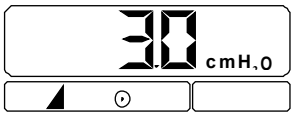
According to the settings limitation it will not be possible to verify the pressure higher than 20 cmH_2O. The pressure verification for 25 cmH_2O can be done only with the computer and the software Silverlining.

Action	Keys(s)	Display
#1-Connect the device on the main power. XX.XX is the current time.		
#2-Press on the two keys opposite and keep them depressed for 2 seconds. The menu displayed opposite appears (Set frequency).	(Hidden Key)	
#3-Press the opposite key to enter in the setting of the IPAP pressure.		
#4-Select P = 14 cmH_2O with the two keys opposite, then press the following key:	▽ △	
#5-Select EPAPA = 14 cmH_2O with the two keys opposite, then press the following key.	▽ △	
#6-Press the opposite key as many times as necessary to return into stand by mode (current time displayed)		
#7-**Turn on the unit and leave running for 1/2 hour**		

Action	Key(s)	Display
Check the measured value on the pressure meter, the value must be **14 cmH_2O ± 0.5.** If yes, go to point #12 If not, go to point #8		
#8-Press on the two keys opposite and keep them depressed for 2 seconds. The menu displayed opposite appears (Set frequency).	(Hidden Key)	
#9-Press the key opposite several times until the display opposite appears (mode calibration). XXX is a value between 0 and 255.		
#10-Adjust the value with the keys opposite until the pressure meter is reading 14 cmH_2O.		
#11-Record the selected value by pressing the hidden key, keeping it depressed and pressing the access key..	(Hidden Key)	
#12-Go to points #2 to #5 and select EPAP=IPAP= 20 cm H_2O.		
Check the measured value on the pressure meter, the value must be **20 cmH_2O ± 0.5**		
#13-Go to points #2 to #5 and select EPAP=IPAP= 3 cmH_2O.		
Check the measured value on the pressure meter, the value must be **3 cmH_2O ± 0.5** **If one of these two verifications is not within specification, set IPAP=EPAP=14 cmH_2O and go to step #8.**		
#14-Press on the key opposite to switch off the units (display the current time). The pressure verification is ended.		

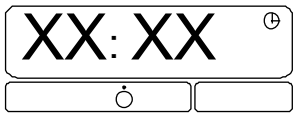
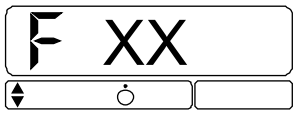
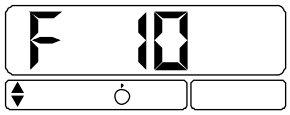
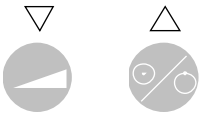
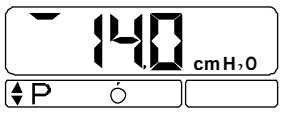
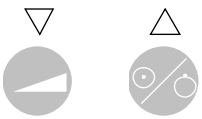
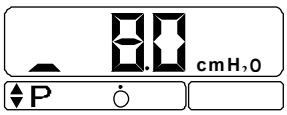
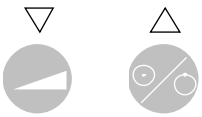
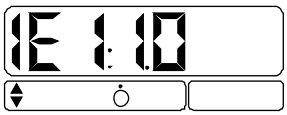
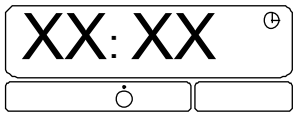
6-b) Verification of the ramp without computer

Realise the test set up figure 3.1 page III-4

Action	Key(s)	Display
#1 to #5-Follow steps #1 to # 5 according to page III-10 and set pressure P= 20 cmH_2O and then-press on the key opposite.		
#6-Press the key opposite to access to the ram time set menu. XX is a value between 0 and 30.		
#7-Select ramp = 5 min. with the two keys opposite.		
#8-Press the key opposite for the display shown opposite to appear (start ramp pressure set mode. XX is the pressure value to set).		
#9-Select the start pressure to 8 cmH_2O with the two keys opposite.		
#10-Press the key opposite several times until stand by mode (current time displayed).		
#11-Switch on the unit and when the pressure has reached 20 cmH_2O, press on the key opposite in order for the pressure to fall down to 3 cmH_2O.		
#12-**Check that the pressure increases from 3 cmH_2O to 20 cmH_2O in 5 minutes +/- 20 seconds.**		

6-c) Verification of the back-up frequency without computer

Realise the test set up figure 3.1 page III-4

Action	Key(s)	Display
#1-Connect the unit on the main power (via the external power supply), XX.XX is displayed. (XX.XX is the current time).		
#2-Press on the two keys opposite and keep them depressed for 2 seconds. The menu displayed opposite appears (Set frequency).	(Hidden Key)	
#3-Press on one of the two keys opposite to set F= 10, and press on the following key:		
#4-Select P = 14 cmH_2O with the two keys opposite, and press on the following key:		
#5-Select P = 8 cmH2O with the two keys opposite, and press on the following key several time to access to the I/E ratio set menu:		
#6-Select I/E ratio = 1:1.0 with the two keys opposite		
#7-Press the opposite key as many time as necessary to return into stand by mode (current time displayed)		
Switch on the unit and verify the pressure to run from EPAP to IPAP 10 time +/- one time per minute.		

7) Configuration with factory settings

a) With the computer

When you select the "Reprogramming device" menu (see page III-6) and you click on "OK", the following two operations occur:

-The reconfiguration erases all recorded data,
-The following default factory parameters are set:

- Back up Frequency: Fr=10 (425ST only)
- IPAP=15
- EPAP=5
- Ramp=15 min
- Start ramp pressure = 3cmH_2O
- I/E Ratio = 1:2.0 (425ST only)
- Inspiratory sensitivity SI=5
- Expiratory sensitivity SE=5
- Rise time: rt=3
- Patient reference: = R + last 7 numerals of the serial number,
- Inventory number = 0000000000.

b) With the Keypad (In case of error message Er 01)

When an Er 01 is displayed the device is not able to communicate with the computer.

-Press on the key:

-The word "Def" is displayed on the device

-Press on the key:

-The default factory parameters will be set:

-The screen remains blank for a few seconds and then returns to normal mode.

8) Entering the serial number and the hour meter values

1- Follow the same steps as those described on pages III-5 to III-6 (Performance Verification).
2- After entering the password (page III-6), click on the "Serial number and meters" menu and follow the screen instructions.

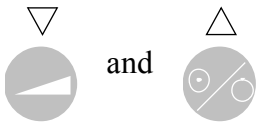
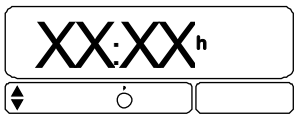
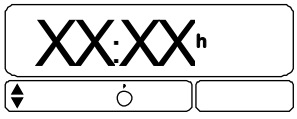
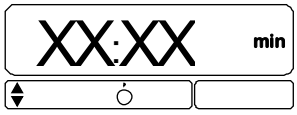
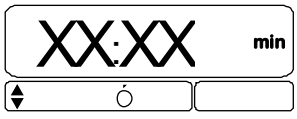
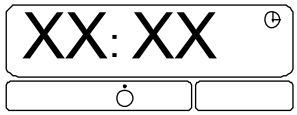
CAUTION

The serial number must match the one printed on the base of the device.
The manufacturer is not responsible for any fraudulent use that might result from modification of the serial number.

9) Service hour meters

The GoodKnight 425/425ST has two additional "tools" to help you in planning the maintenance of your device.
These two meters can be customized (choice of the name) and can be reset as necessary.
To use it, follow the steps described on pages III-5 and III-6. After entering the password (page III-6), click on the "Serial number and meters" menu and follow the screen instructions.

10) Setting the clock with the keypad.

Action	Key(s)	Display
#1-The device is in stand-by mode (the clock is displayed). Press the first key opposite and keep depressed. Then press the second key opposite and release the two keys simultaneously. The display shown opposite appears (XX:XX is the clock value to be set). The letter "h" flashes and the hour value is ready to be adjusted.		
#2-Adjust the hours with the two keys opposite		
#3-Press the key opposite to adjust the minutes. The display shown opposite appears. The letters "min" flash and the minute value is ready to be adjusted.		
#4-Adjust the minutes with the two keys opposite.		
#5-Press the key opposite to return to stand-by mode. (XX:XX is new set time).		

NOTE

The setting of date can be done only with the software Silverlining.

Personal Notes

B. CALIBRATION PROCEDURE

1) Equipment required

- a calibrated pressure meter
- a calibrated leak **M-BH210** and a connection tube **M-213530-05,**
- a patient circuit **M-261000-27,**
- a test kit **M-212430-02**

NOTE

The calibration pressure mode is accessed via the keypad.

The pressure calibration can be also performed by computer using Silverlining software. Refer to page III-5 and III-6, click on the "Calibration" menu and follow the instructions.

CAUTION

Measure the pressure during calibration at the end of a 6 ft (1.80 m) patient circuit sealed with a stopper fitted with a 4 mm diameter leak (figure 3.1 page III-4).

CAUTION

Allow to warm up for 1/2 hour before performing the pressure calibration

2) Pressure sensor calibration

Connect a patient circuit and a pressure meter as shown in figure 3-1 on page III-4

The pressure sensor calibration can be done with a computer and the Technical Menu of the software Silverlining (procedure described III-7), or with the keypad (procedure described page III-10).

NOTE

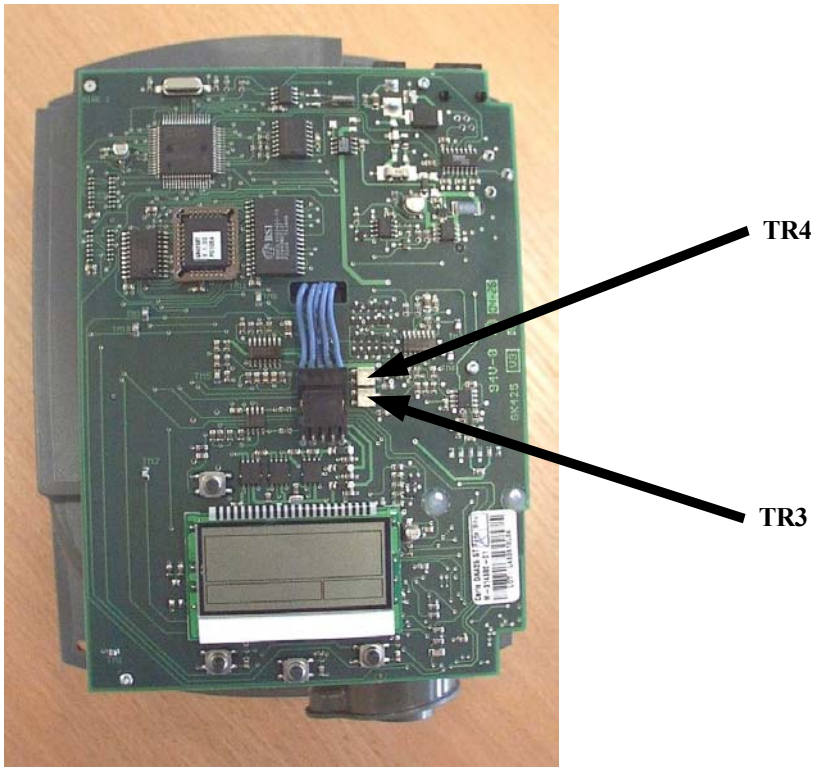
The pressure calibration with the keypad does not allow to verify the pressure higher than 20 cmH_2O

The pressure calibration with the keypad does not reboot the unit with the initial settings.

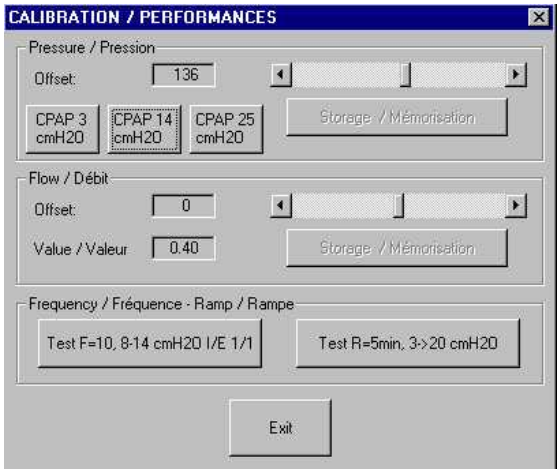
3) Flow sensor calibration

3-a) Set up material

1-Remove the top housing (refer to the disassembly section page III-22),
2-Locate on the MCU board the trimmers TR3 and TR4,
3-Realise the test set up figure 3.1 page III-4



4-Connect the unit to the computer,
5-Follow the steps described page III-5 to III-6 and click on "Calibrations/Performances", the following menu will appear.

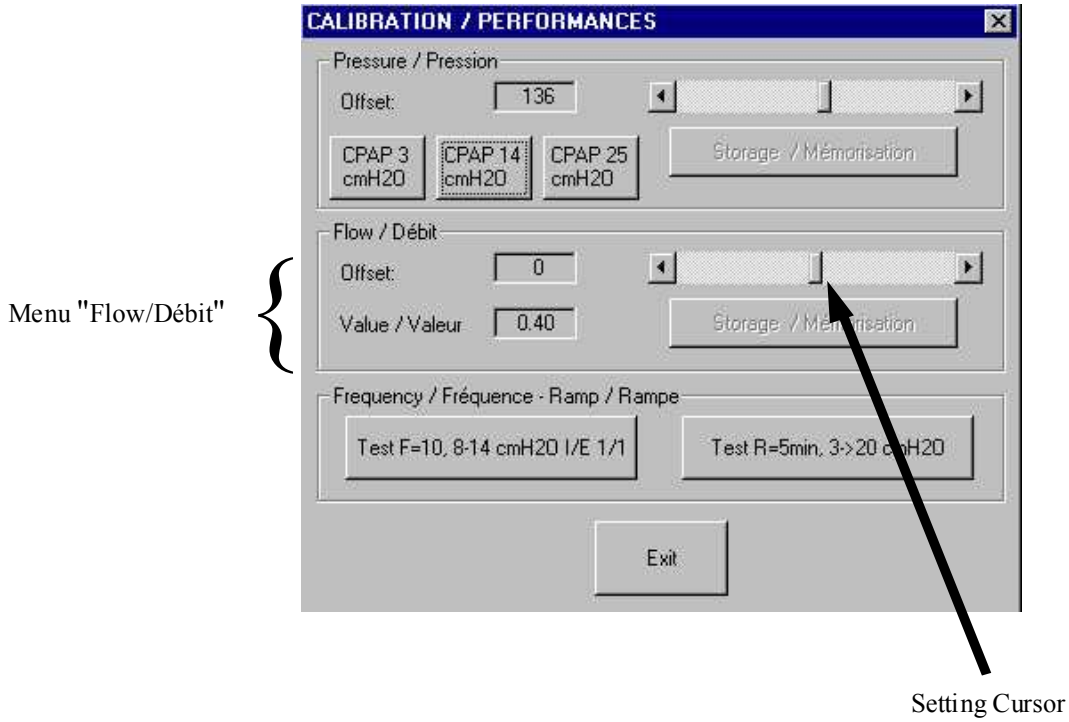


3-b) Calibration

CAUTION

Allow to warm up for 1/2 hour with a set pressure of 14cmH_2O, unit in Cpap mode, before carrying out the pressure calibration.

1-Replace the test kit with the calibrated output (figure 3.2 page III-4) **and block the output**
2-With the mouse, click on the setting cursor of the menu "Flow/Débit" and adjust the **Offset** to **0**,
3-Store with the button "Storage",
4-Place TR4 in a medium position,
5-Adjust TR3 for a **Value/Valeur** reading of **0 l/s +/-0.05** (Value of Flow in the "Flow/Débit" menu),
6-Leave the calibrated output free and adjust TR4 for a **Value/Valeur** reading of:
1.2 l/s +/-0.05,
7-Block again the calibrated output and verify that the value reading is:
0 l/s +/-0.05.
If not, repeat the process from the step #5.



C. DISASSEMBLY

Material :

A Torx T10 screwdriver,
A grounded wrist strap,
A grounded conductive mat.

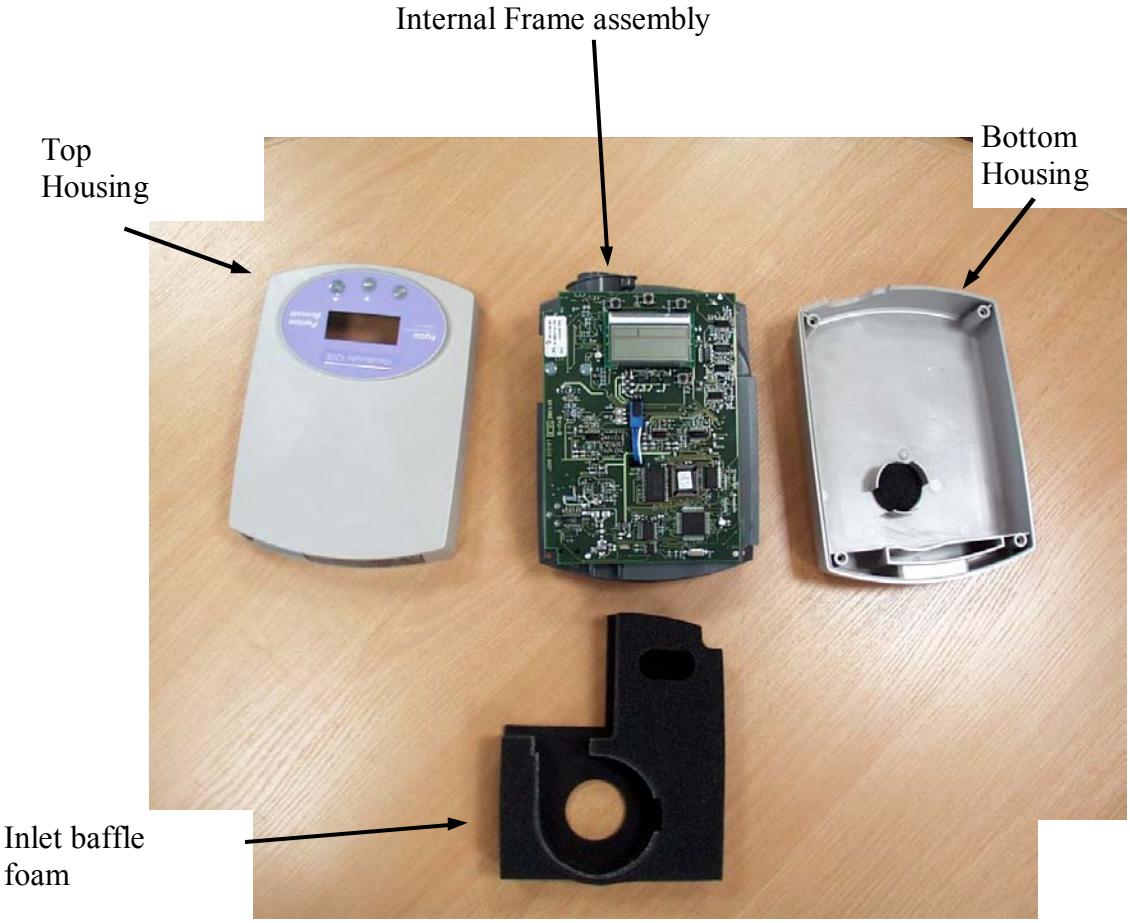
WARNING

The GK 425/425ST BiLevel System is electrically powered. To prevent serious injury or death, follow standard safety procedures. Ensure that power has been disconnected from the unit before servicing any component.

-Remove the four screws located under the device,
-Remove the top housing,
-Remove the chassis assembly.

CAUTION

After replacing the chassis assembly, enter the serial number and the hour meter value in the device memory if necessary


Internal Frame assembly
Top Housing
Bottom Housing
Inlet baffle foam

D. TROUBLESHOOTING GUIDE

PROBLEM	PROBABLE CAUSE	SUGGESTIONS
The device does not produce the correct pressure.	The ramp is activated.	-Check that the ramp indicator is displayed. Press the ramp button to cancel the function. -Call your Technical Support
The air output of the device is too hot.	The air input filters may be dirty. The air input is obstructed. The room temperature is too high.	-Clean or replace the filters accordingly. Move away any bed linen or clothing from the GK425/425ST. -Turn the room thermostat down. Make sure that the GK425/425ST is not near any source of heat. -Remove the tube from under the covers. -Call your Technical Support
The GK425/GK425ST does not switch on (no display).	Check that the external power supply module is correctly connected. No mains supply.	-Check the connection of the external power supply module to the mains plug. -Use another appliance (e.g.: lamp, radio, etc) to check that there is an AC current supply at the plug. -Call your Technical Support
The device does not work correctly and appears to be suffering interference	Excessive electromagnetic disturbance	-Keep device away from all sources of disturbance, such as mobile phones, halogen lights... -Call your Technical Support
Er=0XX is displayed (xx =error code).	The device has detected an operating fault.	-Refer to the "Error Messages" section on page III-26. -Call your Technical Support

PROBLEM	PROBABLE CAUSE	SUGGESTIONS
In 01 is displayed.	The mask and/or the patient tube is disconnected.	-Check the connection between mask, patient tube and device. The message disappears once the connections are correctly established. -Call your Technical Support.
In 02 is displayed.	Excess pressure (higher than 28 cmH_2O) has been detected by the device for more than 10 seconds.	-Check the connection of the small pressure point hose. Check that the tube is not pinched or blocked. -Call your Technical Support
In 03 is displayed.	There is a drop in power.	-Check the connection between the external power module, the power cable and the device. -Check the external battery if used. -Call your Technical Support
In 04 is displayed.	A high frequency (higher than 30 cycles per minutes) has been detected for more than 10 minutes.	-Check the connection of the small pressure point hose. Check that the tube is not pinched or blocked or moistly or dusty (refer to user manual of the circuit patient). -Call your Technical Support

E. ERROR MESSAGES

CODE	DESCRIPTION	CORRECTIVE ACTION
Er01	-Settings data checksum error. or -The unit is staying set with a EPAP value > 20cmH_2O after a technical action.	-Perform reconfiguration (refer to page III-14). -If the message persists, change the internal frame assembly (see page III-22).
Er02	A too high temperature has been detected by the temperature sensor. (refer to page II-4 §5).	-Unplug the unit from all electrical sources for a few seconds and try again. -If the message persists, change the internal frame assembly (see page III-22).
Er06	Checksum error in the Master micro-controller firmware.	-Unplug the unit from all electrical sources for a few seconds and try again. -If the message persists, change the internal frame assembly (see page III-22).
Er07	The blower does not work.	-Unplug the unit from all electrical sources for a few seconds and try again. -If the message persists, change the internal frame assembly (see page III-22).
Er08	Problem with internal 5V voltage	-Unplug the unit from all electrical sources for a few seconds and try again. -If the message persists, change the internal frame assembly (see page III-22).
Er10	Power limit reached	-Unplug the unit from all electrical sources for a few seconds and try again. -If the message persists, change the internal frame assembly (see page III-22).
Er11	Over consumption	-Unplug the unit from all electrical sources for a few seconds and try again. -If the message persists, change the internal frame assembly (see page III-22).
Er15	Error in recorded setting.	-Unplug the unit from all electrical sources for a few seconds and try again. -If the message persists, change the internal frame assembly (see page III-22).
Er16	Problem with link between master micro-controller and memory.	-Unplug the unit from all electrical sources for a few seconds and try again. -If the message persists, change the internal frame assembly (see page III-22).
Er 17	Checksum error in the Motor micro-controller firmware.	-Unplug the unit from all electrical sources for a few seconds and try again. -If the message persists, change the internal frame assembly (see page III-22).

CODE	DESCRIPTION	ACTION CORRECTIVE
Er18	Problem with link between motor micro-controller and memory	-Unplug the unit from all electrical sources for a few seconds and try again. -If the message persists, change the internal frame assembly (see page III-22).
Er19	Problem with the Bi-Level setting data regarding the motor driver.	-Unplug the unit from all electrical sources for a few seconds and try again. -If the message persists, change the internal frame assembly (see page III-22).
Er40	Bus I2C Motor not available	-Unplug the unit from all electrical sources for a few seconds and try again. -If the message persists, change the internal frame assembly (see page III-22).
Er41	Bus I2C Master not available	-Unplug the unit from all electrical sources for a few seconds and try again. -If the message persists, change the internal frame assembly (see page III-22).

♦ HISTORY RECORD FORM

At the end of this manual, you will find an example of the GoodKnight 425/425ST History Record Form.

This form will help you in all the stages of servicing.

This form can be copied.

We recommend that you send a copy of the completed forms to your local Factory Service.

How to fill out the following items

Return number This is the official Return Goods Authorization (RGA) or your own return number if RGA does not exist.

Failure description Describe the failure in a few words or state “Routine Service” if this is the case.

Servicing done Describe in a few words what you have done in the service.

Report number Enter here your report number if not the same as the return number.

Personal Notes

IV - SPARE PARTS

Part #	Description
M-314530-00	Top Housing equipped 425 International
M-314530-01	Top Housing equipped **425ST** International
M-314530-02	Top Housing equipped 425 USA
M-314530-03	Top Housing equipped 425**ST** USA
M-313940-01	Bottom housing 425 / 425ST
M-314560-00	Internal frame assembly 425 (equipped with blower and electronic board factory set). Inlet baffle foam not included.
M-314560-01	Internal frame assembly **425ST** (equipped with blower and electronic board factory set). Inlet baffle foam not included.
M-413950-01	Inlet baffle foam 425 / 425ST
M-414510-00	External power module 425 / 425ST.
M-660600-04	Power lead Europe.
M-660600-40	Power lead UK
M-660600-39	Power lead USA
M-660600-41	Power lead Australia
M-711902-01	Torx T10 screw for housing.

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HISTORY RECORD FORM (1/2)

GoodKnight425 ☐ **GoodKnight 425ST** ☐

SERIAL #		CUSTOMER	
RETURN #		REPORTING #	
DATE		Compliance Meter #	
Hour Meter (Before servicing)		Hour Meter (After servicing)	
Embedded Ver. (Before servicing)		Embedded Ver. (After servicing)	

Failure _____

_____

Error messages and information recorded in the memory :

Error Messages	*Information Messages*
1. _____	1. _____
2. _____	2. _____
3. _____	3. _____
4. _____	4. _____
5. _____	5. _____

Servicing Done _____

_____

Power supply: Good ☐ Defect ☐

Parts changed

Part number	*Description*	*Lot #*	*Serial*

Reconfiguration (1): Yes — No

Verification of the serial# in the memory ☐

(1): Surround the good answer

☐ Fill with a value

Calibrations and tests ⇩

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HISTORY RECORD FORM (2/2)

PERFORMANCES VERIFICATION

Pressure

3 cmH_2O set ⇨ measured ____ cmH_2O

14 cmH_2O set ⇨ measured ____ cmH_2O

25 cmH_2O set ⇨ measured ____ cmH_2O

Ramp

Test succeeded (1) Yes — No

Flow (*step* **#1**) ____ l/s

Flow (*step* **#2**) ____ l/s

Backup Frequency (**425ST**)

Setting: *F=10 IPAP=14 EPAP=8 I/E=1:1.0*

Measured Frequency ____ c/min

CALIBRATION

Pressure sensor

1) Adjustment 14 cmH2O: Value displayed (before adjustment) ____

Measured Pressure (before adjustment) ____ cmH_2O

Value displayed (after adjustment) ____

2) Verification 25 cmH2O: Pressure measured with controller: ____ cmH_2O

3) Verification 3 cmH_2O: Pressure measured with controller: ____ cmH_2O

Flow sensor

Adjustment with TR3: Value: ____ l/s (Offset =0, calibrated output blocked)

Adjustment with TR4: Value: ____ l/s (Offset =0, calibrated output free)

Observations

_____

_____

(1)= Surround the good answer

▭ Fill with a value

Operator ____

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